

Effects of tachycardia, increased afterload and contractility on right ventricular myocardial oxygen balance in acutely instrumented pigs

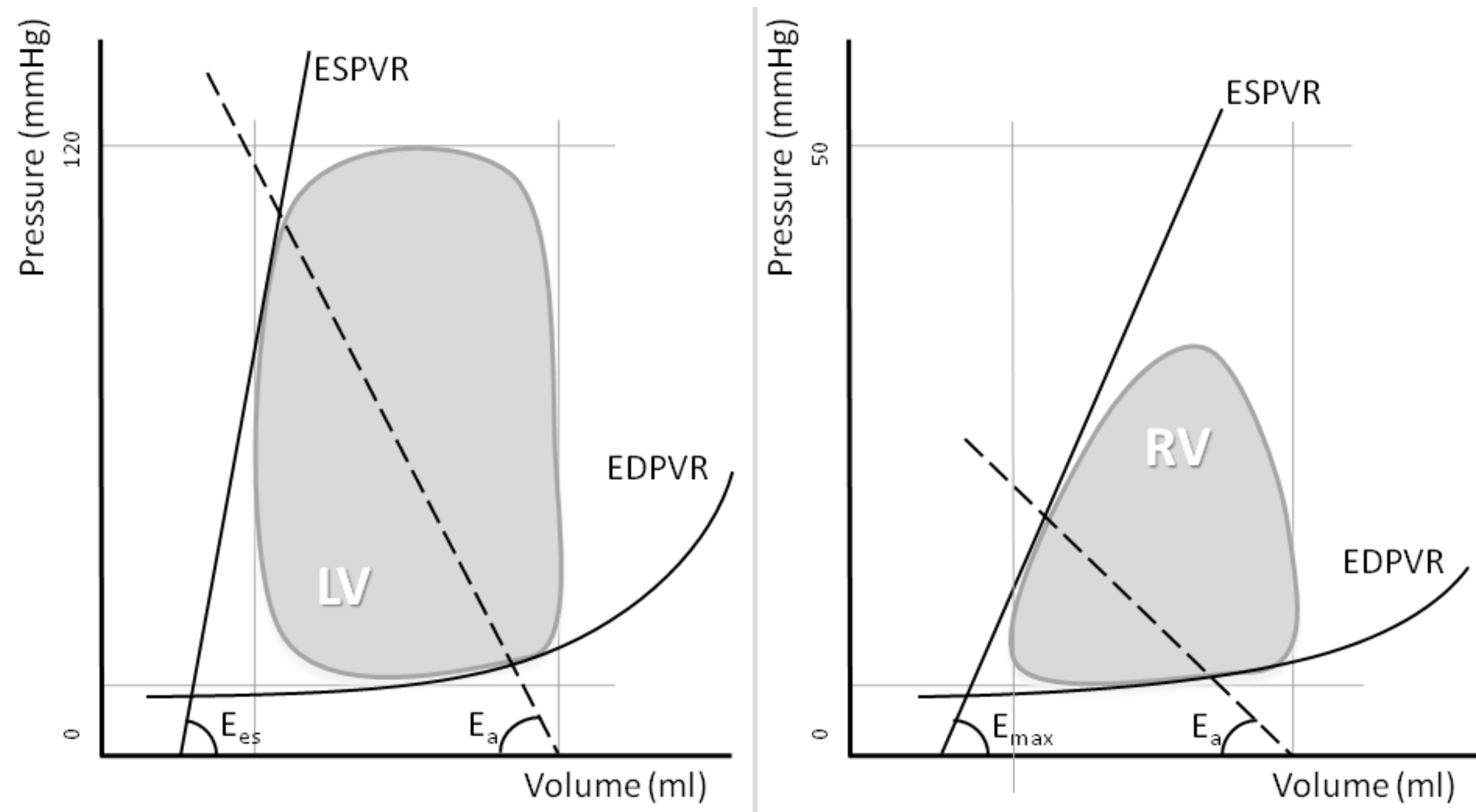
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Background

Importance of right ventricular (RV) failure in the perioperative setting:

- Morbidity and mortality (chronic heart failure, ARDS, PHT)
- Perioperative mortality higher in RV failure
- Similar incidence as LV failure

RV ≠ LV: Anatomic and physiologic differences



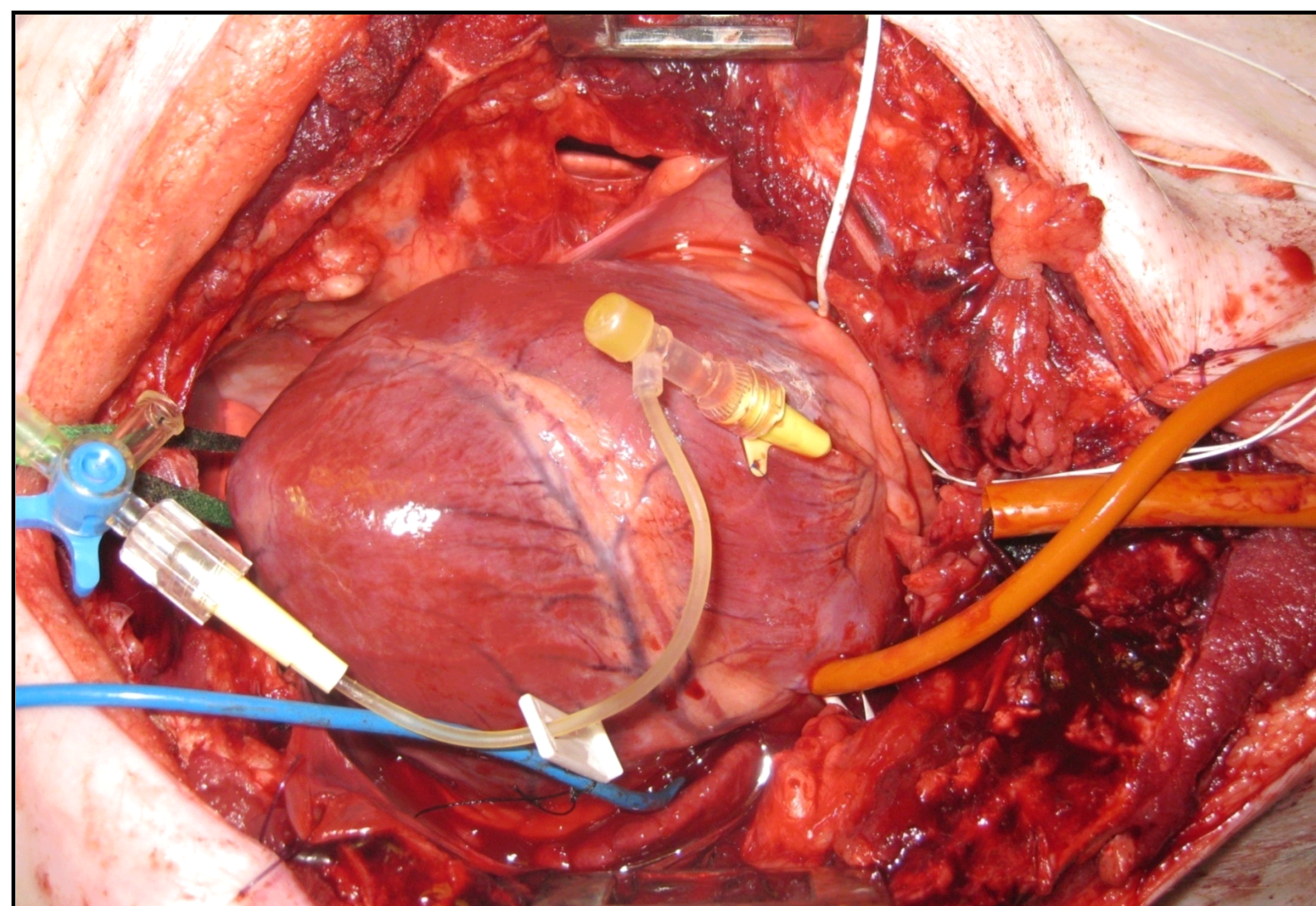
Goal

We assessed the relative role of right coronary blood flow versus oxygen extraction ratio (OER) during hemodynamic conditions associated with increased RV oxygen demand as they may occur perioperatively.

Materials and Methods

Imposed challenges:

1. Atrial pacing (140 bpm)
→ Tachycardia
2. Pulmonary artery banding (triple arterial elastance increase)
→ Afterload
3. Dobutamine ($6 \mu\text{g} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$)
→ Inotropy



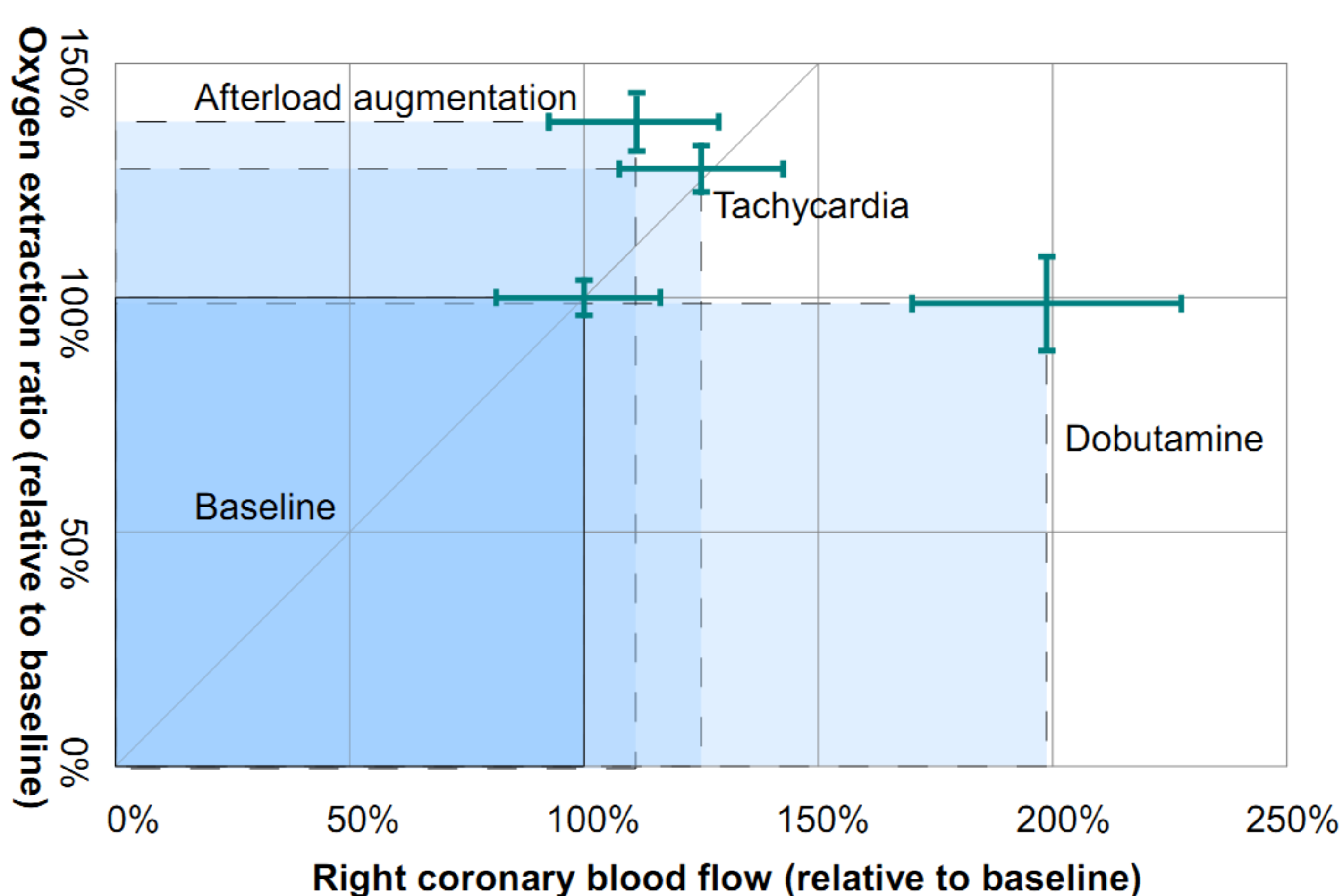
Measurements:

Arterial blood gas
Selective RV venous blood gas
Right coronary blood flow
→ RV myocardial oxygen data

Analysis:

- Crossover design
- Paired student's t-testing

Results



The area of the blue squares represents the myocardial oxygen consumption.

± standard Deviation	MVO ₂ (mlO ₂ ·min ⁻¹)	rCBF (ml·min ⁻¹)	OER (%)
Baseline	1.98 ± 0.26	32.6 ± 6.1	50.9 ± 2.4
Tachycardia (n=9)	2.93 ± 0.69 (p=0.002 vs BL)	40.9 ± 6.3 (p=0.033 vs BL)	64.8 ± 2.8 (p=0.012 vs BL)
Acute AL raise (n=7)	3.08 ± 0.55 (p=0.0041 vs BL)	36.2 ± 5.7 (p=0.11 vs BL)	70.7 ± 2.7 (p=0.001 vs BL)
Dobutamine (n=5)	3.28 ± 0.64 (p=0.009 vs BL)	65.1 ± 9.5 (p=0.0009 vs BL)	50.2 ± 5.0 (p=0.28 vs BL)

- All overload types raised RV oxygen consumption (MVO₂)
- In tachycardia, coronary blood flow ↑ and OER ↑
- With afterload augmentation, only OER ↑
- With dobutamine, only coronary flow ↑

Conclusions

- RV has significant oxygen extraction reserve (OER)
- OER is maximal in the presence of increased RV afterload
 - Intramural RV pressures may oppose a rise in right coronary blood flow
- Tachycardia associated with higher OER as compared to dobutamine induced positive ino- and chronotropic stimulation
 - Counter-intuitive: heart rate should not affect the duration of coronary perfusion in the RV
 - This suggests a direct coronary vasodilatory effect of dobutamine, and deserves further investigation